JOURNEYMAN INTERNATIONAL : DWELL BEING
JONESTOWN, MISSISSIPPI

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SPRING 2021

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SECTION 1.0 : REPORT OVERVIEW

ABSTRACT

Journeyman International is a non-profit organization that works with countries all over the world to support humanitarian projects by pairing clients with design professionals and volunteers to oversee the design and construction of projects. This specific project partners with Third Lens Ministries and But God Ministries, two organizations that are hoping to empower the community in Jonestown, Mississippi. Dwell Being promotes sustainability and affordable housing in a new housing community in Jonestown that is designed for healthy living and community interaction. Jonestown is a very small 0.4 square acre town that has roots in systemic racism and oppression. A once very prosperous agricultural area now lacks basic resources and has an alarming poverty rate of almost 50 percent. The home structure will be apart of a community that incorporates shared lawns, gardens, and other spaces promoting outdoor activity. The structure follows a classic southern dogtrot style house with two housing spaces connected by a breezeway. A clearstory creates a high roof and a low roof and thus disconnects the living spaces from the private spaces. The high roof includes a loft for additional living or sleeping space. The advantage of a duplex style home is the ability to have multiple households of a multi-generational household. This is important because of the low mobility out of Jonestown. The increase in housing promotes ownership and participation in a stagnant community. Additionally, this report includes a research portion for a possible solution to increase the affordability and access to Dwell Being by converting it to a manufactured home.

IMPACT : GLOBAL

The global impact this project provides can be found in its goals to find affordable housing solutions. The United States Department of Housing and Urban Development defines the affordability of housing based on a 30 percent rule, meaning that housing should take up 30 percent or less of an individuals salary. In the United States today this is nearly impossible. For a community such as Jonestown experiencing such a high rate of poverty and low rate of mobility, it is extremely important to address housing issues. As new technologies contribute to the increase in standards of across America and the world, the ability to afford housing decreases. The concluding research report proposes a solution idea to use manufactured housing instead of onsite construction. If widely accepted, this could realistically be a possible solution to increase housing affordability, especially for large development projects such as this one in Jonestown.

IMPACT : CULTURAL

For a town that has a population that is 100 percent African American, the cycles of poverty and stagnation are evidence of racism and oppression. Currently Jonestown has a lower rate of high school graduation (68.6%) than the rest of Mississippi (85.3%), more than double the rate of poverty than in Mississippi (43% and 20%), and has less than half the median household income in Mississippi ($17K and $45K). These factors make it very hard for residents to move outside of Jonestown to seek better opportunities and routes for success. This project being a part of a greater community development helps to foster relations among residents of Jonestown to share ideas and create relationships. This is important in pursuing interaction within the community and outside the community. The increase in manufactured homes would be quite possible in Jonestown as already, 22 percent of the homes there are manufactured. The stigma that manufactured homes are unaesthetic and symbols of poverty is disproved by the ability to design very nice manufactured home designs. The classic mobile home trailer can be replaced by a more modern family home with large windows and a sloped roof.

IMPACT : SOCIAL

This community design creates pocket neighborhoods with homes that share lawns, gardens, and recreational facilities to promote healthy living and interaction. Additionally, residents in Jonestown suffer from food insecurity despite Mississippi being an agriculturally driven state. Community gardens will help to provide locally sourced food at a cheaper cost. The new development will ideally encourage people to move to Jonestown and therefore boost the local economy. The development of new homes will also increase home ownership which is an important step in overcoming poverty.

IMPACT : ENVIRONMENTAL

One of the goals of Dwell Being is to create as sustainable a project as possible. A solution to this is to utilize hempcrete for insulation. Hemp is a fast growing and a carbon sequestering natural building material that when mixed with lime and water creates a durable insulator to use as infill in structural framing. Hempcrete can be left unfinished or easily finished with plaster. For a very humid Delta region, this material can also help with regulating the high temperatures and humidity experienced in Jonestown. This project utilizes an empty plot of land, thus no wildlife or trees have to be removed in order for the development to occur. The project incorporates solar paneling systems to help reduce energy consumption. The clearstory separating the high roof from the low roof provides natural light to avoid unnecessary use of electricity. These details help to make a more environmentally friendly and energy efficient home for residents in Jonestown.

IMPACT : ECONOMIC

The main goal of this project is to create an affordable housing solution for the impoverished community of Jonestown. The ability to serve multiples households or a single multi-generational household in the duplex allows for the most economic efficiency. For unoccupied units, owners could lease the space for additional units. Smaller units could also function as a workspace. The affordability is further increased with manufactured homes. Detailed research at the end of this report outlines the significant impact that manufactured housing has for the ability of people that have access to more affordable housing. By having the project built on site, about 40 percent of people in Jonestown cannot comfortably afford it. However by using a manufactured model, this percentage is cut in half.

PERSONAL REFLECTION

One of my main goals as a college graduate is to use my Architectural Engineering degree to help people. I aspire to apply my engineering practicality to address real world issues that cannot necessarily be solved by codes or calculations. This project gave me the opportunity to use what I have learned to participate in a project that seeks to find sustainable and affordable housing solutions. The most significant thing I realized is that as engineers we are already conditioned to determine the most efficient and practical solution. The most economically efficient solution has already been found and that is what we use. I learned that by thinking out of the box and suggested a more unconventional idea, that my desire to actually be more economical is possible. The biggest challenge with this project was communicating with different disciplines virtually. Typically we are taught that this is already the most difficult aspect of working in the real world. With the pandemic, this was heightened. Typically affordable housing is not the primary goal. While communicating with the architect on many occasions I had to remind her that some of her design ideas would make it more difficult to me to create an affordable structural design. For example, we struggled to decide on a foundation system that was easy to construct and did not lead to more issues such as flooding. After taking a Google Maps tour through Jonestown, I saw that the majority of the structures had simple slab on grade foundations. While these systems are not the most effective with potential flooding, the implementation of gardens and landscaping can help to decrease over saturation of water. The research component was most valuable to me because I was able to see the impact of poverty on the ability to find housing. For a project designed to address affordable housing issues, it was estimated to actually be quite expensive. I enjoyed the opportunity to analyze the significance of housing that is actually affordable and how little of these homes there actually are.

TEAM REFLECTION

The team members for this project include Margy Maher, a fifth year Architecture major, Joshua de Mattei, a fourth year Construction Management major, and myself. We all had very similar goals in mind for this project. Our biggest issue was lack of communication and consistent meetings to overview progress and changes. This is an important lesson as we enter industry. Overall I would assign out group a 3.75 rating out of 5 for our lack of consistent coordination and peer review.

SECTION 2.0 : CALCULATION PACKAGE

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: LOADS
NAME: AUTUMN WAGNER
DATE:

LOAD TAKEOFF

TYPICAL ROOF DEAD LOADS			
Description	Rafters	Beams	Lateral
Corrugated Metal	3	3	3
1/2" Plywood	1.5	1.5	1.5
Insulation	0.5	0.5	0.5
1/2" Gypsum	2	2	2
Rafters	4	4	4
Total	*11*	*11*	*11*
Horizontal Projection	*11.27*	*11.27*	*11.27*
Beam		3	3
Mech + Plumb	3	3	3
Misc.	3	3	3
TOTAL	17.3	20.3	20.3
USE (PSF)	**17**	**20**	**20**

slope: 0.22
factor: 1.02439

Notes:
1) 1/2" plywood = 0.4psf/(1/8")*4

LIVE LOADS		
Roof	20 PSF	Live Load Reduction Allowed
Habitable Attic (Loft)	30 PSF	Live Load Reduction Allowed

Notes:
1) Loading in accordance with ASCE 7-16 Chapter 4

LOFT DEAD LOADS			
Description	Joists	Beams	Lateral
1/2" Plywood	1.5	1.5	1.5
1/2" Gypsum	2	2	2
Joists	3	3	3
Beams		3	3
Misc.	3	3	3
TOTAL	9.5	12.5	12.5
USE (PSF)	**10**	**13**	**13**

LATERAL LOADS		
ESTIMATED LOAD (HIGH)		
Lime Plaster (2/3)	8	PSF
Single Paned Windows (1/3)	5	PSF
Hempcrete Insulation	13.3	PSF
Stud Framing	2	PSF
1/2" Gypsum Wall	2	PSF
DL Contribution	20	PSF
Misc.	2	PSF
Total	46	PSF
ESTIMATED LOAD (LOW)		
Wood Siding (2/3)	5	PSF
Single Paned Windows (1/3)	5	PSF
Hempcrete Insulation	13.3	PSF
Stud Framing	2	PSF
Wall 5/8" drywall	3	PSF
DL Contribution	13	PSF
Misc.	2	PSF
Total	38	PSF

Notes:
1) hempcrete = (10"/12)*16pcf

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

RAFTER DESIGN (SHORT)

LOADS

D = 17 PSF (SEE TAKEOFF)

L = 20 PSF

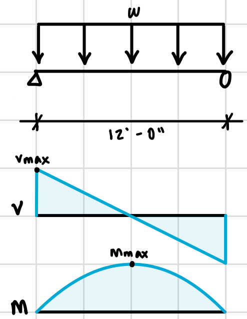
ℓ = 12'-0"

T.W. = 16" OC

LIVE LOAD REDUCTION? ASCE 7-16 4.8.2

A_T = 12'-0" (1.33') = 16 ft²

A_T < 200 ft² ∴ NO



USE 17 PSF (1.33') = 23 PLF

20 PSF (1.33') = 27 PLF

TOTAL = 23 PLF (D) + 27 PLF (L) = 50 PLF

DESIGN LIMITS

$V_{MAX} = w\ell/2$ = 300 #

$M_{MAX} = w\ell^2/8$ = 900 #'

SIZE USING DEFLECTION LIMIT

DEFLECTION LIMIT = $\ell/240$ (nonplaster Δ_L) IBC T.1604.3

$\Delta = 5w\ell^4/384EI$

$\ell/240 = 5w\ell^4/384EI$

∴ $I_{min} = 1200\, w\ell^3/384E$

USE E = 1,600,000 in⁴ (SOUTHERN PINE NO.1)

$$I_{min} = \frac{1200\,(27\text{ PLF})(1'/12")(12'\text{-}0")^3(12"/')^3}{384(1{,}600{,}000\text{ in}^4)}$$

= 13 in⁴

TRY 2x6

I = 20.8 in⁴

A = 8.25 in²

S = 7.56 in³

GRAVITY DESIGN

RAFTER DESIGN (SHORT)

MODIFICATION FACTORS

$C_d = 1.25$ NDS 2.3.2

$C_L = 1.0$ NDS 3.3.3

$C_F = 1.1$ (F_b) NDS 4.3.6

$C_r = 1.15$ NDS 4.3.9

$C_t = 1.0$ NDS 2.3.3

$C_M = 1.0$ NDS 4.1.4, 5.1.4

REFERENCE VALUES

$F_b = 1{,}350$ psi NDS TABLE 4B

$F_v = 175$ psi NDS TABLE 4B

CHECK BENDING

$f_b = M/S$

$= 900\#'(12''/') \,/\, 7.56\ in^3$

$= 1{,}429$ psi

$F_b' = F_b C_D C_M C_t C_L C_{Fu} C_i C_r$

$= 1{,}350\,psi\,(1.25)(1.1)(1.15)$

$= 2{,}135$ psi

$d/c = 0.67 \therefore$ OK ✓

CHECK SHEAR

$f_v = 1.5V/A$

$= 1.5(300\#) \,/\, 8.25\ in^2$

$= 54.5$ psi

$F_v' = F_v C_D C_M C_t C_i$

$= 175\,psi\,(1.25)$

$= 219$ psi

$d/c = 0.25 \therefore$ OK ✓

USE 2x6 @ 16" OC

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

RAFTER DESIGN (LONG)

LOADS

D = 17 PSF (SEE TAKEOFF)

L = 20 PSF

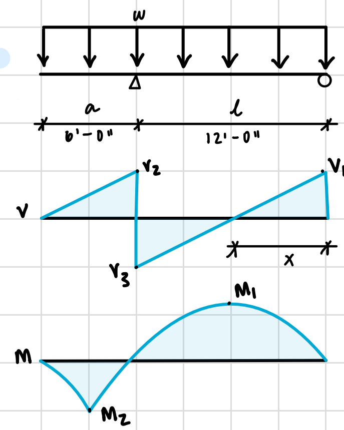
ℓ = 12'-0" + 6'-0" CANTILEVER

T.W. = 16" oc

LIVE LOAD REDUCTION? ASCE 7-16 4.8.2

A_T = 18'-0" (1.33') = 24 ft²

A_T < 200 ft² ∴ NO



USE 17 PSF (1.33') = 23 PLF
20 PSF (1.33') = 27 PLF

TOTAL = 23 PLF (D) + 27 PLF (L) = 50 PLF

DESIGN LIMITS AISC T3-23 (24)

$V_1 = w/2\ell\,(\ell^2 - a^2)$
= 50 PLF / 2(12') [(12')² − (6')²] = 225 #

$V_2 = wa$
= 50 PLF (6') = 300 #

$V_3 = w/2\ell\,(\ell^2 + a^2)$
= 50 PLF / 2(12') [(12')² + (6')²] = 375 # ← GOVERNS

$M_1 = w/8\ell^2\,(\ell + a)^2(\ell - a)^2$
= 50 PLF / 8(12')² (12'+6')² (12'−6')² = 506 #'

$M_2 = wa^2/2$
= 50 PLF (6')² / 2 = 900 #' ← GOVERNS

SIZE USING BENDING LIMIT

F_b^* = 1,350 (1.25)(1.15) = 1,940 psi

∴ $S_{min} = M_{max} / F_b^*$
= 900 #' (12"/1') / 1,940 psi
= 5.57 in³

TRY 2 X 6

I = 20.8 in⁴

A = 8.25 in²

S = 7.56 in³

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

RAFTER DESIGN (LONG)

MODIFICATION FACTORS

$C_d = 1.25$ NDS 2.3.2

$C_L = 1.0$ NDS 3.3.3

$C_F = 1.1\ (F_b)$ NDS 4.3.6

$C_r = 1.15$ NDS 4.3.9

$C_t = 1.0$ NDS 2.3.3

$C_M = 1.0$ NDS 4.1.4, S.1.4

REFERENCE VALUES

$F_b = 1{,}350$ psi NDS TABLE 4B

$F_v = 175$ psi NDS TABLE 4B

$E = 1{,}600{,}000$ psi NDS TABLE 4B

CHECK BENDING

$f_b = M/S$

$= 900\#'(12''/') \,/\, 7.56\ in^3$

$= 1429$ psi

$F_b' = F_b C_D C_M C_t C_L C_{Fu} C_i C_r$

$= 1{,}350\,psi\,(1.25)(1.1)(1.15)$

$= 2{,}135$ psi

$d/c = 0.67 \therefore$ OK ✓

CHECK SHEAR

$f_v = 1.5V/A$

$= 1.5(375\#) \,/\, 8.25\ in^2$

$= 68$ psi

$F_v' = F_v C_D C_M C_t C_i$

$= 175\,psi\,(1.25)$

$= 219$ psi

$d/c = 0.31 \therefore$ OK ✓

CHECK DEFLECTION

DEFLECTION LIMIT $= \ell/240$ (nonplaster Δ_L) IBC T.1604.3

$\therefore \Delta_{all} = 0.9''$

Δx (BETWEEN SUPPORTS):

$\Delta = wx/24EI\ell\,(\ell^4 - 2\ell^2x^2 + \ell x^3 - 2a^2\ell^2 + 2a^2x^2)$

$w = 27\,plf\,('/12)$ $\quad E = 1.6\times10^4\,psi$

$x = 6'(12''/') = 72''$ $\quad I = 20.8\,in^4$

$\ell = 12'(12''/') = 144''$ $\quad a = 6'(12''/') = 72''$

$\therefore \Delta = 0.15'' < 0.9'' \therefore$ OK ✓

Δx (OVERHANG):

$\Delta = wx/24EI\,(4a^2\ell - \ell^3 + 6a^2x_1 - 4ax_1^2 + x_1^3)$

$w = 27\,plf\,('/12)$ $\quad E = 1.6\times10^4\,psi$

$x = 6'(12''/') = 72''$ $\quad I = 20.8\,in^4$

$\ell = 12'(12''/') = 144''$ $\quad a = 6'(12''/') = 72''$

$\therefore \Delta = 0.75'' < 0.9''(2) = 1.8'' \therefore$ OK ✓

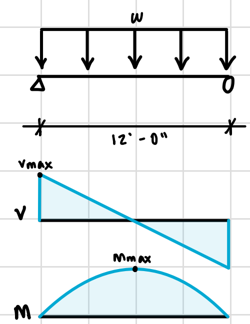
↑ CANTILEVER

USE 2x6 @ 16" OC

GRAVITY DESIGN

LOFT FRAMING

LOADS



D = 10 PSF (SEE TAKEOFF)

L = 30 PSF

ℓ = 12'-0"

T.W. = 12" OC

USE 10 PSF (1.33') = 13 PLF

30 PSF (1.33) = 40 PLF

TOTAL = 13 PLF (D) + 40 PLF (L) = 53 PLF

DESIGN LIMITS

$V_{MAX} = w\ell/2$ = 318 #

$M_{MAX} = w\ell^2/8$ = 954 #'

SIZE USING DEFLECTION LIMIT

DEFLECTION LIMIT = $\ell/360$ IBC T.1604.3

$\Delta = 5w\ell^4/384EI$

$\ell/240 = 5w\ell^4/384EI$

$\therefore I_{min} = 1200w\ell^3/384E$

USE E = 1,600,000 in⁴ (SOUTHERN PINE NO.1)

$$I_{min} = \frac{1200\,(30\text{ PLF})(1'/12")(12'\text{-}0")^3(12"/1')^3}{384(1{,}600{,}000\text{ in}^4)}$$

$= 19.4 \text{ in}^4$

TRY 2x6

$I = 20.8 \text{ in}^4$

$A = 8.25 \text{ in}^2$

$S = 7.56 \text{ in}^3$

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

LOFT FRAMING

MODIFICATION FACTORS

$C_d = 1.0$ NDS 2.3.2

$C_L = 1.0$ NDS 3.3.3

$C_F = 1.1 \ (F_b)$ NDS 4.3.6

$C_r = 1.15$ NDS 4.3.9

$C_t = 1.0$ NDS 2.3.3

$C_M = 1.0$ NDS 4.1.4, 5.1.4

REFERENCE VALUES

$F_b = 1{,}350$ psi NDS TABLE 4B

$F_v = 175$ psi NDS TABLE 4B

CHECK BENDING

$f_b = M/S$

$= 954\ \#'(12''/') \ / \ 7.56\ in^3$

$= 1{,}514$ psi

$F_b' = F_b\, C_D\, C_M\, C_t\, C_L\, C_{fu}\, C_i\, C_r$

$= 1{,}350\, psi\, (1.0)(1.1)(1.15)$

$= 1{,}708$ psi

$d/c = 0.89 \therefore$ OK ✓

CHECK SHEAR

$f_v = 1.5V/A$

$= 1.5(318\ \#) \ / \ 8.25\, in^2$

$= 57.8$ psi

$F_v' = F_v\, C_D\, C_m\, C_t\, C_i$

$= 175\, psi\, (1.0)$

$= 175$ psi

$d/c = 0.33 \therefore$ OK ✓

USE 2x6 @ 16" OC

GRAVITY DESIGN

LOFT BEAM

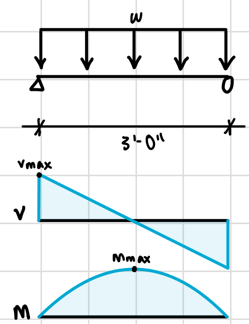
LOADS

D = 13 PSF (SEE TAKEOFF)

L = 30 PSF

ℓ = 12'-0"

TW = 6'-0"



USE 13 PSF (6'-0") = 78 PLF

30 PSF (6'-0") = 180 PLF

TOTAL = 78 PLF (D) + 180 PLF (L) = 258 PLF

DESIGN LIMITS

$V_{MAX} = w\ell/2 = 1548\#$

$M_{MAX} = w\ell^2/8 = 4644\#'$

SIZE USING DEFLECTION LIMIT

DEFLECTION LIMIT = $\ell/240$ IBC T.1604.3

$\Delta = 5w\ell^4/384EI$

$\ell/240 = 5w\ell^4/384EI$

$\therefore I_{min} = 1800w\ell^3/384E$

USE E = 1,600,000 in⁴ (SOUTHERN PINE NO.1)

$$I_{min} = \frac{1800(180\,PLF)(1'/12")(12'-0")^3(12"/1')^3}{384(1,600,000\,in^4)} = 131\,in^4$$

TRY (2) 2X8

$I = 47.63(2) = 95.26\,in^4$

$A = 10.88(2) = 21.76\,in^2$

$S = 13.14(2) = 26.28\,in^3$

GRAVITY DESIGN

LOFT BEAM

MODIFICATION FACTORS

$C_d = 1.0$ NDS 2.3.2

$C_L = 1.0$ NDS 3.3.3

$C_F = 1.1\ (F_b)$ NDS 4.3.6

$C_r = 1.0$ NDS 4.3.9

$C_t = 1.0$ NDS 2.3.3

$C_M = 1.0$ NDS 4.1.4, 5.1.4

REFERENCE VALUES

$F_b = 1{,}250\ psi$ NDS TABLE 4B

$F_v = 175\ psi$ NDS TABLE 4B

CHECK BENDING

$f_b = M/S$

$= 4644\#' (12''/') \,/\, 13.14(2)\ in^3$

$= 2121\ psi$

$F_b' = F_b\, C_D\, C_M\, C_t\, C_L\, C_{Fu}\, C_i\, C_r$

$= 1250\ psi\ (1.0)(1.1)(1.0)(2)$ DOUBLE

$= 2750\ psi$

$d/c = 0.77 \therefore OK$ ✓

CHECK SHEAR

$f_v = 1.5V/A$

$= 1.5(1548\#) \,/\, 10.88\ in^2\ (2)$

$= 107\ psi$

$F_v' = F_v\, C_D\, C_m\, C_t\, C_i$

$= 175\ psi\ (1.0)(2)$ DOUBLE

$= 350\ psi$

$d/c = 0.3 \therefore OK$ ✓

USE DOUBLE 2x8 SISTERED W/ 1/2" PLYWOOD SHIM

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

HEADER DESIGN (DOOR)

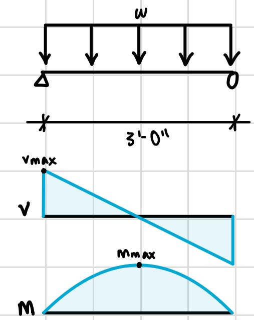
LOADS

D = 20 PSF (SEE TAKEOFF)

L = 20 PSF

ℓ = 3'-0"

TW = 12'-0" + 3'-0" (CANT.) = 15'-0"



USE 20 PSF (15'-0") = 300 PLF

20 PSF (15'-0") = 300 PLF

WALL: h above hdr = 5'-0"

D = 26 PSF (5'-0") = 130 PLF

TOTAL = 300 PLF (D) + 300 PLF (L) + 130 PLF (WALL) = 730 PLF

DESIGN LIMITS

$V_{MAX} = w\ell/2$ = 1,095 #

$M_{MAX} = w\ell^2/8$ = 821 #'

SIZE USING DEFLECTION LIMIT

DEFLECTION LIMIT = $\ell/240$ IBC T.1604.3

$\Delta = 5w\ell^4/384EI$

$\ell/240 = 5w\ell^4/384EI$

$\therefore I_{min} = 1800w\ell^3/384E$

USE E = 1,600,000 in⁴ (SOUTHERN PINE NO.1)

$$I_{min} = \frac{1800(300\,PLF)(1'/12")(3'-0")^3(12"/1')^3}{384(1,600,000\,in^4)} = 3.46\,in^4$$

TRY (2) 2x4

I = 5.359(2) = 10.72 in⁴

A = 5.25(2) = 10.5 in²

S = 3.06(2) = 6.12 in³

GRAVITY DESIGN

HEADER DESIGN (DOOR)

MODIFICATION FACTORS

$C_d = 1.0$ NDS 2.3.2
$C_L = 1.0$ NDS 3.3.3
$C_F = 1.1\ (F_b)$ NDS 4.3.6
$C_r = 1.0$ NDS 4.3.9
$C_t = 1.0$ NDS 2.3.3
$C_M = 1.0$ NDS 4.1.4, 5.1.4

REFERENCE VALUES

$F_b = 1{,}650$ psi NDS TABLE 4B
$F_v = 175$ psi NDS TABLE 4B

CHECK BENDING

$f_b = M/S$
$= 821\ \#'(12''/') / 6.12\ in^3$
$= 1610$ psi
$F_b' = F_b\, C_D\, C_M\, C_t\, C_L\, C_{fu}\, C_i\, C_r$
$= 1650\ psi\ (1.0)(1.0)(1.1)$
$= 1815$ psi
$d/c = 0.89\ \therefore$ OK ✓

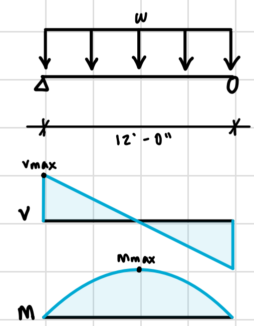
CHECK SHEAR

$f_v = 1.5V/A$
$= 1.5(1095\#) / 10.5\ in^2$
$= 156$ psi
$F_v' = F_v\, C_D\, C_M\, C_t\, C_i$
$= 175 psi\ (1.0)$
$= 175$ psi
$d/c = 0.86\ \therefore$ OK ✓

USE DOUBLE 2x4 w/ 1/2" PLYWOOD SHIM

GRAVITY DESIGN

HEADER DESIGN (WINDOW W/O LOFT WORST CASE)



LOADS

D = 20 PSF (SEE TAKEOFF)

L = 20 PSF

ℓ = 6'-0"

TW = 12'-0" + 3'-0" (CANT.) = 15'-0"

USE 20 PSF (15'-0") = 300 PLF

20 PSF (15'-0") = 300 PLF

WALL: h above hdr = 5'-0"

D = 26 PSF (5'-0") = 130 PLF

TOTAL = 300 PLF (D) + 300 PLF (L) + 130 PLF (WALL) = 730 PLF

DESIGN LIMITS

$V_{MAX} = w\ell/2$ = 2190 #

$M_{MAX} = w\ell^2/8$ = 3285#'

SIZE USING DEFLECTION LIMIT

DEFLECTION LIMIT = $\ell/240$ IBC T.1604.3

$\Delta = 5w\ell^4/384EI$

$\ell/240 = 5w\ell^4/384EI$

$\therefore I_{min} = 1800w\ell^3/384E$

USE E = 1,600,000 in⁴ (SOUTHERN PINE NO.1)

$$I_{min} = \frac{1{,}800(300\,PLF)(1'/12")(6'-0")^3(12"/1')^3}{384(1{,}600{,}000\,in^4)} = 27.6\,in^4$$

TRY (2) 2X8

I = 47.63(2) = 95.26 in^4

A = 10.88(2) = 21.76 in^2

S = 13.14(2) = 26.28 in^3

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

HEADER DESIGN (WINDOW W/O LOFT WORST CASE)

MODIFICATION FACTORS

$C_d = 1.0$ NDS 2.3.2

$C_L = 1.0$ NDS 3.3.3

$C_F = 1.1\ (F_b)$ NDS 4.3.6

$C_r = 1.0$ NDS 4.3.9

$C_t = 1.0$ NDS 2.3.3

$C_M = 1.0$ NDS 4.1.4, 5.1.4

REFERENCE VALUES

$F_b = 1{,}250$ psi NDS TABLE 4B

$F_v = 175$ psi NDS TABLE 4B

CHECK BENDING

$f_b = M/S$

$= 3285\#'(12''/') \,/\, 13.14(2)\ in^3$

$= 1{,}500$ psi

$F_b' = F_b\, C_D\, C_M\, C_t\, C_L\, C_{fu}\, C_i\, C_r$

$= 1250\ psi\ (1.0)(1.1)(1.0)(2)$ DOUBLE

$= 2{,}750$ psi

$d/c = 0.55 \therefore$ OK ✓

CHECK SHEAR

$f_v = 1.5V/A$

$= 1.5(2190\#) \,/\, 10.88\ in^2\ (2)$

$= 151$ psi

$F_v' = F_v\, C_D\, C_m\, C_t\, C_i$

$= 175psi\ (1.0)(2)$ DOUBLE

$= 350$ psi

$d/c = 0.43 \therefore$ OK ✓

USE DOUBLE 2x8 SISTERED W/ 1/2" PLYWOOD SHIM

GRAVITY DESIGN

HEADER DESIGN (WINDOW W/ LOFT)

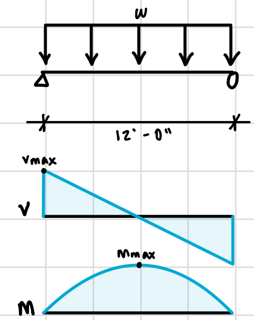
LOADS

D = 20 PSF + 13 PSF (SEE TAKEOFF)

L = 30 PSF

ℓ = 6'-0"

TW = 12'-0" + 3'-0" (CANT.) = 15'-0"



USE 33 PSF (15'-0") = 495 PLF

30 PSF (15'-0") = 450 PLF

WALL: h above hdr = 5'-0"

D = 26 PSF (5'-0") = 130 PLF

TOTAL = 495 PLF (D) + 450 PLF (L) + 130 PLF (WALL) = 1075 PLF

DESIGN LIMITS

$V_{MAX} = w\ell/2$ = 3,225 #

$M_{MAX} = w\ell^2/8$ = 4,838 #'

SIZE USING DEFLECTION LIMIT

DEFLECTION LIMIT = $\ell/240$ IBC T.1604.3

$\Delta = 5w\ell^4/384EI$

$\ell/240 = 5w\ell^4/384EI$

$\therefore I_{min} = 1800w\ell^3/384E$

USE E = 1,600,000 in⁴ (SOUTHERN PINE NO.1)

$$I_{min} = \frac{1800(450\,PLF)(1'/12")(6'-0")^3(12"/1')^3}{384(1,600,000\,in^4)} = 27.6\,in^4$$

TRY (2) 2X8

$I = 47.63(2) = 95.26\,in^4$

$A = 10.88(2) = 21.76\,in^2$

$S = 13.14(2) = 26.28\,in^3$

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

HEADER DESIGN (WINDOW W/ LOFT)

MODIFICATION FACTORS

C_d = 1.0 NDS 2.3.2

C_L = 1.0 NDS 3.3.3

C_F = 1.1 (F_b) NDS 4.3.6

C_r = 1.0 NDS 4.3.9

C_t = 1.0 NDS 2.3.3

C_M = 1.0 NDS 4.1.4, 5.1.4

REFERENCE VALUES

F_b = 1,250 psi NDS TABLE 4B

F_v = 175 psi NDS TABLE 4B

CHECK BENDING

$f_b = M/S$

$= 4{,}838\#'(12''/') / 13.14(2)\ in^3$

$= 2{,}209$ psi

$F_b' = F_b C_D C_M C_t C_L C_{fu} C_i C_r$

$= 1250\ psi\ (1.0)(1.1)(1.0)(2)$ DOUBLE

$= 2{,}750$ psi

d/c = 0.8 ∴ OK ✓

CHECK SHEAR

$f_v = 1.5V/A$

$= 1.5(3225\#) / 10.88\ in^2\ (2)$

$= 222$ psi

$F_v' = F_v C_D C_m C_t C_i$

$= 175\ psi\ (1.0)(2)$ DOUBLE

$= 350$ psi

d/c = 0.64 ∴ OK ✓

USE DOUBLE 2x8 SISTERED W/ 1/2" PLYWOOD SHIM

GRAVITY DESIGN

HEADER DESIGN (CLEARSTORY)

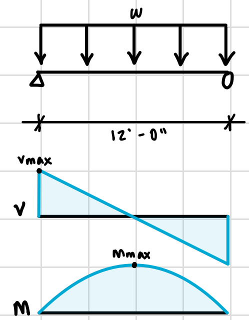
LOADS

D = 17 PSF (SEE TAKEOFF)

L = 20 PSF

ℓ = 3'-0"

TW = 1'-0"



USE 17 PSF (1'-0") = 17 PLF
20 PSF (1'-0") = 20 PLF

TOTAL = 17 PLF (D) + 20 PLF (L) = 37 PLF

DESIGN LIMITS

$V_{MAX} = w\ell/2 =$ 56 #

$M_{MAX} = w\ell^2/8 =$ 42 #'

SIZE USING DEFLECTION LIMIT

DEFLECTION LIMIT = $\ell/240$ IBC T.1604.3

$\Delta = 5w\ell^4/384EI$

$\ell/240 = 5w\ell^4/384EI$

$\therefore I_{min} = 1800w\ell^3/384E$

USE E = 1,600,000 in⁴ (SOUTHERN PINE NO.1)

$$I_{min} = \frac{1{,}800(20\ \text{PLF})(1'/12")(3'-0")^3(12"/1')^3}{384(1{,}600{,}000\ in^4)} = 0.23\ in^4$$

TRY 2 x 4

$I = 5.359\ in^4$

$A = 5.25\ in^2$

$S = 3.06\ in^3$

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

HEADER DESIGN (WINDOW W/O LOFT WORST CASE)

MODIFICATION FACTORS

$C_d = 1.25$ NDS 2.3.2

$C_L = 1.0$ NDS 3.3.3

$C_F = 1.1\ (F_b)$ NDS 4.3.6

$C_r = 1.0$ NDS 4.3.9

$C_t = 1.0$ NDS 2.3.3

$C_M = 1.0$ NDS 4.1.4, 5.1.4

REFERENCE VALUES

$F_b = 1{,}500\ psi$ NDS TABLE 4B

$F_v = 175\ psi$ NDS TABLE 4B

CHECK BENDING

$f_b = M/S$

$= 42\#'(12''/')\ /\ 3.06\ in^3$

$= 165\ psi$

$F_b' = F_b\, C_D\, C_M\, C_t\, C_L\, C_{Fu}\, C_i\, C_r$

$= 1500 psi\ (1.0)(1.1)(1.25)$

$= 2063\ psi$

$d/c = 0.1\ \therefore$ OK ✓

CHECK SHEAR

$f_v = 1.5V/A$

$= 1.5(56\ \#)\ /\ 5.25\ in^2$

$= 16\ psi$

$F_v' = F_v\, C_D\, C_m\, C_t\, C_i$

$= 175 psi\ (1.0)$

$= 175\ psi$

$d/c = 0.1\ \therefore$ OK ✓

USE 2x4 HDRS ABOVE CLEARSTORY WINDOWS

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: WIND LOADING
NAME: AUTUMN WAGNER
DATE:

LATERAL FORCES

WIND ANALYSIS

ASCE 7-16 Ch.27

↳ SIMPLIFIED DIRECTIONAL METHOD

CRITERIA

RISK: II ASCE7-16 T.1.5-1

EXPOSURE: C ASCE7-16 §26.7

BASIC SPEED = 112 MPH ASCE 7-16 F.26.5-1b

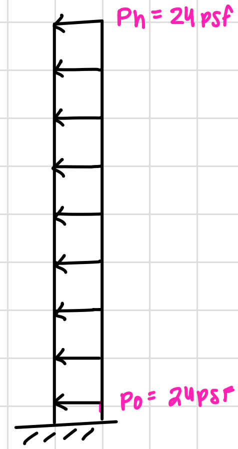
K_{ZT} = 1.0 (FLAT) ASCE 7-16 §26.8-1

CLASS I BLDG

(SIMPLE DIAPHRAGM, h ≤ 60', 0.2 ≤ L/b ≤ 5.0) ASCE7-16 §27.4.2

H = 12'-0"

L/B RATIO = 30' / 24' = 1.25 SAY 1.0 ASCE7-16 §27.5.1



LOADING DIAGRAM

WALL PRESSURE @ 115 MPH ASCE7-16 T.27.5-1

* USING h = 15 ft IN TABLE

P_h = 25.2 PSF

P_o = 25.2 PSF

SCALE TO 112 MPH

$P_h = 25.2(112/115)^2 =$ 24 PSF

$P_o = 25.2(112/115)^2 =$ 24 PSF

MIN PRESSURE = 16 PSF ASCE 7-16 § 27.1.5 ✓

BASE SHEAR

P_{AVE} = 24 PSF

$A_{WALL\,E/W} = 30'(10') = 300\ ft^2$

$A_{WALL\,N/S} = 24'(10') = 240\ ft^2$

$V_{WIND\,E/W} = 300\ ft^2\ (24\ PSF) =$ **7,200#**

$V_{WIND\,N/S} = 240\ ft^2\ (24\ PSF) =$ **5,760#**

GRAVITY DESIGN

STUD DESIGN

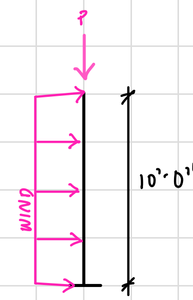
LOADS

D = 17 PSF (SEE TAKEOFF)

L = 20 PSF

h = 10'-0"

TW = 16" OC



USE 17 PSF (1.33') = 23 PLF

20 PSF (1.33') = 27 PLF

WALL: h = 10'-0"

D = 26 PSF (1.33') = 35 PLF

TOTAL = 23 PLF (D) + 27 PLF (L) + 35 PLF (WALL) = 85 PLF

WIND = 24 PSF (0.6 ASD)(1.33') = 19 PLF

DESIGN LIMITS

COMPRESSIVE LOAD P = 85 PLF (10'-0")

= 850 #

WIND MOMENT M = 19 PLF (10'-0")² / 8

= 238 #'

SIZE USING AXIAL LIMIT

$f_c = P/A$

∴ $A = P/f_c$

$f_c^* = f_c C_d$

USE f_c = 1650 psi (SOUTHERN PINE NO.1)

∴ f_c^* = 1650 psi (1.0) = 1650 psi

∴ A = 850 # / 1650 psi = 0.52 in²

TRY 2x4 STUDS

A = 5.25 in², S = 3.06 in³

GRAVITY DESIGN

STUD DESIGN

MODIFICATION FACTORS

$C_d = 1.0$ NDS 2.3.2

$C_L = 1.0$ NDS 3.3.3

$C_F = 1.1\ (F_b)$ NDS 4.3.6

$C_r = 1.0$ NDS 4.3.9

$C_t = 1.0$ NDS 2.3.3

$C_M = 1.0$ NDS 4.1.4, 5.1.4

REFERENCE VALUES

$F_c = 1650\text{ psi}$ NDS TABLE 4B

$F_b = 1350\text{ psi}$ NDS TABLE 4B

$E_{min} = 580{,}000\text{ psi}$ NDS TABLE 4B

CALC C_P NDS SUPP. 3.7.1

$l_e/d = 10'\text{-}0''(12''/') / 3.5''$

$= 34 < 50 \therefore OK$

$F_{cE} = \dfrac{0.822 E_{min}}{(l_e/d)^2}$

$= \dfrac{0.822(580{,}000\text{psi})}{34^2} = 412$

$F_c^* = f_c C_d C_F = 1650\text{psi}(1.0)(1.1) = 1815\text{psi}$

$\therefore C_P = \dfrac{1 + F_{cE}/F_c^*}{2c} - \sqrt{\left(\dfrac{1 + F_{cE}/F_c^*}{2c}\right)^2 - \dfrac{F_{cE}/F_c^*}{c}}$

$c = 0.8$ (SAWN LUMBER)

$\therefore C_P = 0.98$

CALC C_L NDS SUPP 3.3.3

$l_u/d = 34 \geq 7 \therefore OK$

$l_e = 1.63 l_u + 3d$

$= 1.63(34) + 3(5.5'') = 72$

$R_B = \sqrt{l_e d / b^2} = \sqrt{72(5.5'')/1.5''^2} = 13.3$

$F_{BE} = 1.2 E_{min} / R_B^2$

$= 1.2(580{,}000\text{psi}) / 13.3^2 = 3955\text{psi}$

$F_b^* = F_b C_d C_F = 1350\text{psi}(1.0)(1.1) = 1485\text{psi}$

$\therefore C_L = \dfrac{1 + F_{BE}/F_b^*}{1.9} - \sqrt{\left[\dfrac{1 + F_{BE}/F_b^*}{1.9}\right]^2 - \dfrac{F_{BE}/F_b^*}{0.95}}$

$\therefore C_L = 0.97$

GRAVITY DESIGN

STUD DESIGN

CHECK COMBINED COMPRESSION | BENDING NDS SUPP. 3.9

$$(f_c/F'_c)^2 + [1 / 1 - f_c / F_{cE} (f_b / F'_b)] \leq 1.0$$

$F'_c = F_c C_D C_M C_t C_F C_i C_P$

$= 1650\,psi\,(1.0)(1.1)(0.98)$

$= 1780\,psi$

$f_c = P/A$

$= 850\# / 5.25\,in^2$

$= 162\,psi$

$F_{cE} = 412\,psi$

$F'_b = F_b C_D C_M C_t C_F C_i C_P$

$= 1350\,psi\,(1.0)(1.1)(0.97)$

$= 1440\,psi$

$f_b = M/S$

$= 238\#' / 3.06\,in^3$

$= 78\,psi$

$\therefore (162\,psi / 1780\,psi)^2 + [1 / 1 - 162\,psi / 412\,psi\,(78\,psi / 1440\,psi)]$

$= 0.1 \leq 1.0 \quad \therefore$ OK ✓

USE 2x4 STUDS @ 16" OC

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: GRAVITY DESIGN
NAME: AUTUMN WAGNER
DATE:

GRAVITY DESIGN

FOOTING DESIGN

USING IBC T.1806.2
fb = 1500 PSF

*ASSUMING CLAY/SILTY CLAY B/C OF EXISTING BORING REPORT AND GEOGRAPHIC AREA

$\sigma = P/A$

$\therefore A = P/\sigma$

P = 850 # (SEE STUD CALCULATIONS)

$\therefore A = 850\,\# / 1500\text{ PSF}$

$= \underline{0.6'}$

IBC 1809.4 → MIN WIDTH IS 12"
MIN DEPTH IS 12"

USE 12" WIDE BY 18" DEEP CONTINUOUS FOOTINGS

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: LATERAL DESIGN
NAME: AUTUMN WAGNER
DATE:

SEISMIC COEFFICIENTS & DESIGN VALUES

PROJECT NAME: Journeyman International
PROJECT NAME: Senior Project
PROJECT LOCATION: Jonestown, Mississipi

Mapped Spectral Accelerations (%g)	
Site Class D	
Ss =	0.5
S1 =	0.15

Site Coefficients (%g)		
Design Site Class	Fa	Fv
	Table 11.4-1	Table 11.4-2
D - Default	1.2	2.30

Adjusted Maximum Considered EQ (MCE) Spectral Response Acceleration Parameters (ASCE 7-16 / 11.4.4)

SMS = Fa*Ss = 0.6
SM1 = Fv*S1 = 0.345

Design Spectral Acceleration Parameters (ASCE 7-16 / 11.4.5)

SDS = 2/3*SMS = 0.4000
SD1 = 2/3*SM1 = 0.2300

Design Coefficients and Factors for Seismic Force-Resisting System (ASCE 7-16 / 12.2)

Response Modification Coefficient, R	6.5
System Overstrength Factor, Ω_0	3
Deflection Amplification Factor, C_d	4
System Limitations (ft)	65

Importance Factor (ASCE 7-16 / 1.5.2)

Nature of Occupancy per Table 16041.5:
Buildings and other structures except those listed in Risk Categories I, III and IV
Occupancy Category: II
Importance Factor, I: 1.0

Seismic Design Category (ASCE 7-16 / 11.6)

Design Category based on S1:	N/A	S1 < 0.75
Design Category based on SDS:	D	*T 11.6-1*
Design Category based on SD1:	D	*T 11.6-2*
Design Seismic Design Category:	**D**	

Period Determination (ASCE 7-16 / 12.8.2)

Structure Type:

Ct =	0.02		*T12.8-2*
x =	0.75		*T12.8-2*
h_n =	12	ft	ht. above the base
T=Ta=Ct*(hn)^x =	0.12895	sec	*EQN 12.8-7*
TL =	8		*FIG 22-14*

Seismic Response Coefficient

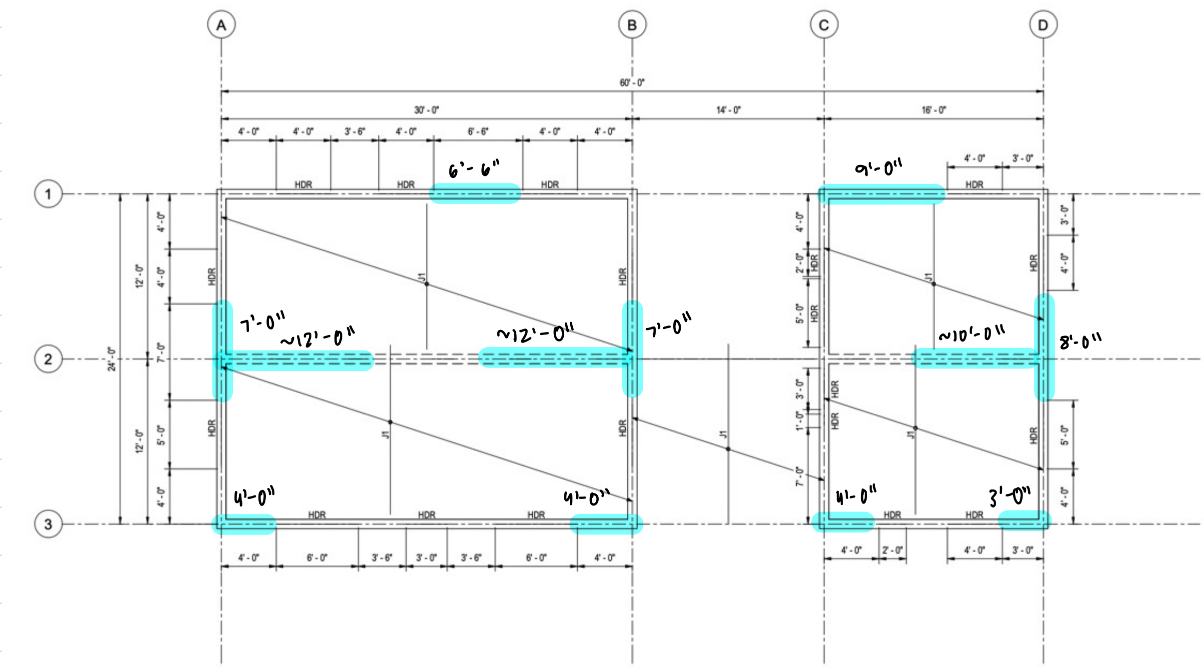
ρ =	1	*SECT 12.3.4.2 (SDC* *removal of one wall results in only 25% reduction in strength
Cs = SDS/(R/I) =	**0.062**	*EQN 12.8-2*
For T<=TL: Cs, max = SD1/(T*R/I) =	0.274	*EQN 12.8-3*
For T>TL : Cs, max = SD1*TL/(T2 *R/I) =	N/A	*EQN 12.8-4*
Cs,min = 0.044*SDS*I >= 0.01	0.018	*EQN 12.8-5*
For S1>=0.6g: Cs min = 0.5*S1/(R/I) =	0.012	*EQN 12.8-6*
V = ρ*Cs*W =	**0.062 * W**	STRENGTH

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: SHEAR WALL LOCATION
NAME: AUTUMN WAGNER
DATE:

SHEARWALL LOCATIONS



MIN ℓ/h = 1:3.5

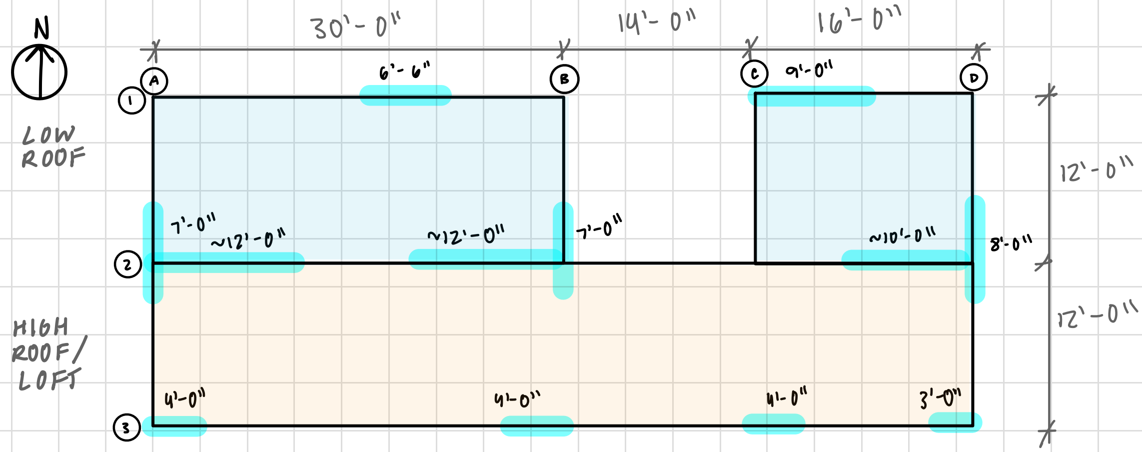
SMALLEST WALL ℓ/h = 3'-0"/10'-0" = 1:3.3$\overline{3}$ ∴ OK

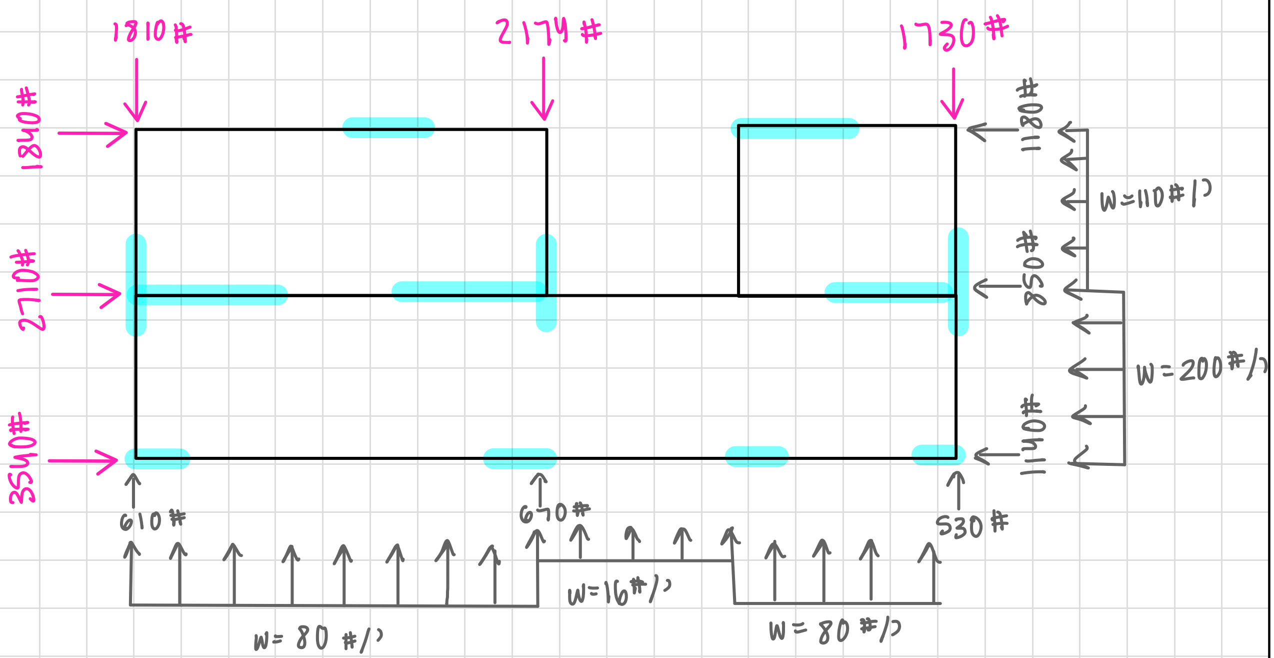
JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: SEISMIC DISTRIBUTION
NAME: AUTUMN WAGNER
DATE:

LATERAL FORCE DISTRIBUTION (SEISMIC)





SUMMARY

N/S

LEFT: 80#/'(15'-0") + 610#

MIDDLE: 80#/'(15'-0") + 16#/'(14'-0") + 80#/'(11'-0") + 670#

RIGHT: 80#/'(15'-0") + 530#

E/W

TOP: 110#/'(6'-0") + 1180#

MIDDLE: 110#/'(6'-0") + 200#/'(6'-0") + 850#

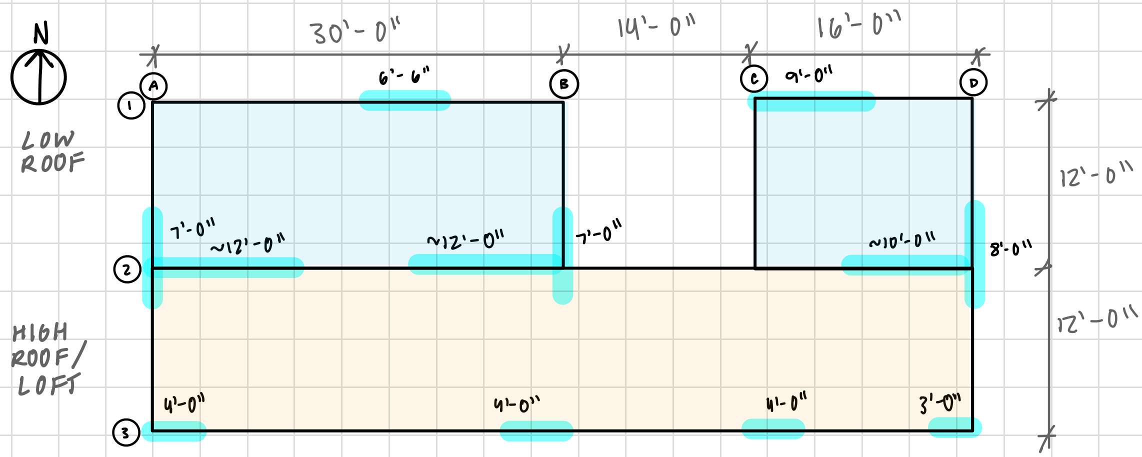
BOTTOM: 200#/'(6'-0") + 1140#

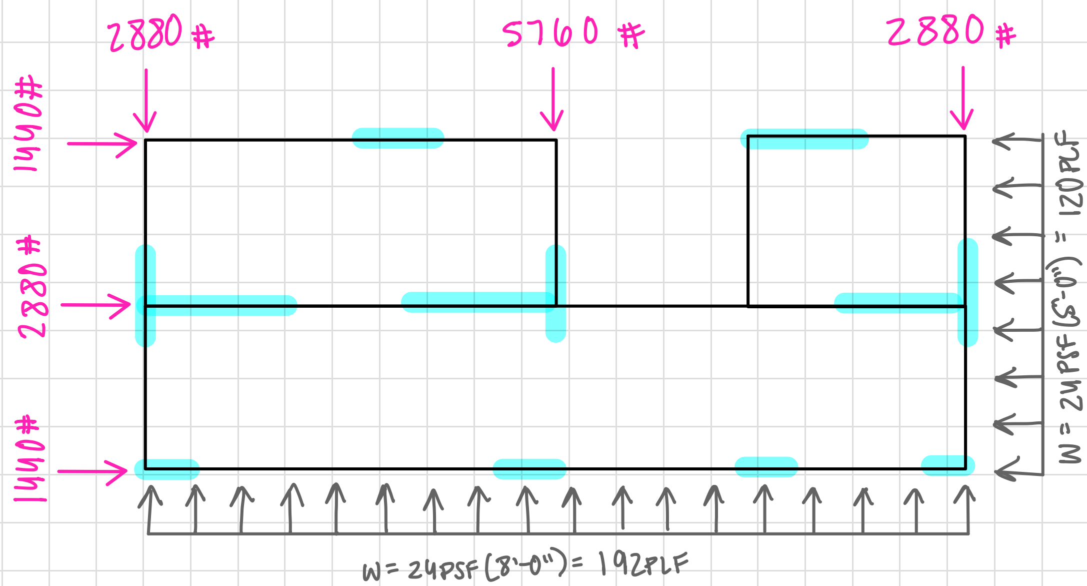
JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: WIND DISTRIBUTION
NAME: AUTUMN WAGNER
DATE:

LATERAL FORCE DISTRIBUTION (WIND)





JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: SEISMIC EXCEL
NAME: AUTUMN WAGNER
DATE:

EXCEL TABLES

BUILDING WEIGHT (HIGH)						
ITEM	**Trib Width (ft)**	**Length (ft)**	**Opening (ft^2)**	**Area Net (ft^2)**	**Weight (PSF)**	**Area x Weight (k)**
Walls	11	70	223	547	19	10.4
Cladding	11	70	223	547	7	3.8
Roof	12	60	0	720	20	14.4
Loft Framing	12	46	0	552	13	7
Weight (k) =						**35.8**

BUILDING WEIGHT (LOW)						
ITEM	**Trib Width (ft)**	**Length (ft)**	**Opening (ft^2)**	**Area Net (ft^2)**	**Weight (PSF)**	**Area x Weight (k)**
Walls	9	70	113	517	19	9.8
Cladding	11	70	113	657	5	3.3
Roof	12	46	0	552	20	11.0
Weight (k) =						**29.5**

STORY FORCES & DIAPHRAGM FORCES

N/S & E/W					Cvx	Fx = Cvx*V	Fx	ΣFx	Ax (coeff.)	Cs
LEVEL	Wx (kips)	ΣWx (kips)	hx (ft)	Wx*hx^k	Wx*hx^k/Σ(wx*hx^k)	Coefficient * W	(kips)	(kips)	Fx/Wx (%g)	0.062
Roof (High)	35.8	36	11	394	0.60	0.037*W	2.42	2	**0.0675**	
Roof (Low)	29.5	65	9	266	0.4027	0.025*W	1.63	4	**0.0553**	
Σ =	65			659	1.00	0.062*W	**4.05**			

1' STRIP E/W wt x Ax					
High Roof/Loft	Area	PSF	Total (kips)	Ax	wt x Ax
Walls	547.0	19	10.4	0.0675	0.702
Cladding	547	7	3.8	0.0675	0.259
Roof	720	20	14.4	0.0675	0.973
Loft Framing	552	13	7	0.0675	0.485
Total / 1' strip (kips/ft)			3.0		**0.20**
Low Roof	Area	PSF	Total (kips)	Ax	wt x Ax
Walls	517.0	19	9.8	0.0553	0.543
Cladding	657	5	3.3	0.0553	0.182
Roof	552	20	11.0	0.0553	0.610
Total / 1' strip (kips/ft)			2.0		**0.11**

Point Loads (E/W)			
Location	Area	PSF	Total (kips)
Top	62	19	1.18
Middle	170	5	0.85
Bottom	60	19	1.14

1' STRIP N/S wt X Ax					
High Roof + Low Roof	Area	PSF	Total (kips)	Ax	wt x Ax
Walls	1064	19	20	0.0614	1.241
Cladding	1204	6	7	0.0614	0.444
Roof	1104	20	22	0.0614	1.356
Loft Framing	552	13	7	0.0614	0.441
Total / 1' strip (kips/ft)			0.9		**0.08**
Breezeway	Area	PSF	Total (kips)	Ax	wt x Ax
Roof	168	20	3.4	0.0675	0.227
Total / 1' strip (kips/ft)			0.1		**0.016**

Point Loads (N/S)			
Location	Area	PSF	Total (kips)
Left	28	19	0.53
Middle	35	19	0.67
Right	32	19	0.61

SHEARWALL DESIGN

N/S

GOVERNING LOAD = WIND

(A) $v = 2880\# / 7'\text{-}0''$
$= 411$ PLF (0.6) = 247 PLF

SDPWS T.4.3A USE 3/8" WOOD STRUCTURAL PANELS W/ 8d NAILS @ 6" OC
Vw = 730/2 = 365 PLF ∴ OK ✓

(B) $v = 5760\# / 7'\text{-}0''$
$= 823$ PLF (0.6) = 494 PLF

SDPWS T.4.3A USE 3/8" WOOD STRUCTURAL PANELS W/ 8d NAILS @ 4" OC
Vw = 1065/2 = 533 PLF ∴ OK ✓

(C) $v = 2880\# / 8'\text{-}0''$
$= 360$ PLF (0.6) = 216 PLF

SDPWS T.4.3A USE 3/8" WOOD STRUCTURAL PANELS W/ 8d NAILS @ 6" OC
Vw = 730/2 = 365 PLF ∴ OK ✓

E/W

GOVERNING LOAD = SEISMIC

(1) $v = 1840\# / 15'\text{-}6''$
$= 119$ PLF (0.7) = 83 PLF

SDPWS T.4.3A USE 3/8" WOOD STRUCTURAL PANELS W/ 8d NAILS @ 6" OC
Vw = 520/2 = 260 PLF ∴ OK ✓

(2) $v = 2710\# / 34'\text{-}0''$
$= 80$ PLF (0.7) = 56 PLF

SDPWS T.4.3A USE 3/8" WOOD STRUCTURAL PANELS W/ 8d NAILS @ 6" OC
Vw = 520/2 = 260 PLF ∴ OK ✓

(3) $v = 3540\# / 15'\text{-}0''$
$= 236$ PLF (0.7) = 165 PLF

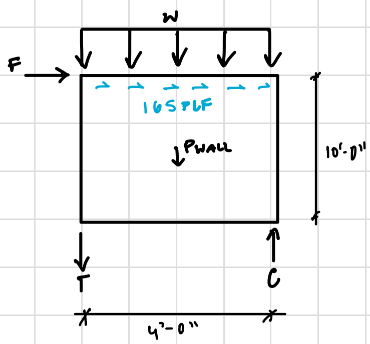
SDPWS T.4.3A USE 3/8" WOOD STRUCTURAL PANELS W/ 8d NAILS @ 6" OC
Vw = 520/2 = 260 PLF ∴ OK ✓

JOURNEYMAN INTERNATIONAL

Senior Project

TOPIC: SHEARWALL DESIGN
NAME: AUTUMN WAGNER
DATE:

SHEARWALL DESIGN (ASSUMED WORST CASE)



LOADS

$W_D = W_{wall} + W_{roof}$

$= 19 psf (4'-0") + 20 psf (10'-0")$

$= \underline{276 PLF}$

$W_L = W_{LR}$

$= 20 psf (10'-0")$

$= \underline{200 PLF}$

$W_{TOT} = \underline{533 PLF}$

$P_{wall} = 19 psf (4'-0")(10'-0")$

$= \underline{760 \#}$

$R_D = W_D l / 2 = \underline{552 \#}$

$R_L = W_L l / 2 = \underline{400 \#}$

T/C COUPLE

(6) : $(1.0 + 0.143 S_{DS}) D + L + \not{S}^0 + \rho Q_E / 1.4$

$\Sigma M_D^{@} = 0 = P_{wall}(2'-0") + W_D(4'-0")(2'-0") + R_D(4'-0") - C(4'-0")$

$= 1330\#(2'-0") + 333 plf(4'-0")(2'-0") + 1165\#(4'-0") - C(4'-0")$

$C_D = \underline{2496 \#}$

$\Sigma M_L^{@} = 0 = W_L(4'-0")(2'-0") - C(4'-0")$

$= 20 psf(4'-0")(2'-0") - C(4'-0")$

$C_L = \underline{40 \#}$

SHEARWALL DESIGN (ASSUMED WORST CASE)

T/C COUPLE CONT.

$Q_e = 165 PLF (10'-0'') = 1650 \#$

$\therefore C = (1.0 + 0.143(0.4))(2496\#) + 40\# + 1.0(1650\#) / 1.4$

$C = 3.9^K$

$(T): (0.9 - 0.143 S_{DS}) D + \rho Q_e / 1.4$

$T = (0.9 - 0.143(0.4))(2496\#) + 1650\# / 1.4$

$\therefore T = 3.2^K$

USE HD5B W/ MINIMUM TENSION LOAD 3785#
USE (2) 2x4 SISTERED AS CHORD

Simpson Strong-Tie® Wood Construction Connectors

SIMPSON Strong-Tie

HDB/HD

Holdowns (cont.)

Holdowns and Tension Ties

These products are available with additional corrosion protection. For more information, see p. 15.

Model No.	Material		Dimensions (in.)							Fasteners (in.)		Minimum Wood Member Size (in.)	Allowable Tension Loads (160)		Deflection at Highest Allowable Load	Code Ref.
	Base (in.)	Body (ga.)	HB	SB	W	H	B	CL	SO	Anchor Dia. Bolt	Stud Bolts		DF/SP	SPF/HF		
HD3B	—	12	4¾	2½	2½	8⅝	2¼	1⁵⁄₁₆	⅜	⅝	(2) ⅝	1½ x 3½	1,895	1,610	0.156	
												2½ x 3½	2,525	2,145	0.169	
												3 x 3½	3,130	3,050	0.12	
												3½ x 3½	3,130	3,050	0.12	
HD5B	³⁄₁₆	10	5¼	3	2½	9⅜	2½	1¼	2	⅝	(2) ¾	1½ x 3½	2,405	2,070	0.153	
												2½ x 3½	3,750	3,190	0.129	
												3 x 3½	4,505	3,785	0.156	
												3½ x 3½	4,935	4,195	0.15	

SECTION 3.0 : DRAWING PACKAGE

GENERAL STRUCTURAL NOTES

- GENERAL

A. EXISTING CONDITIONS - THE CONTRACTOR IS RESPONSIBLE TO VERIFY EISTING SITE CONDITIONS AND UTILITIES TO DETERMINE WHETHER THERE IS A CONFLICT.

B. MEANS AND METHODS, RESPONSIBILITY - CONSTRUCTION DOCUMENTS REPRESENT THE FINISHED STRUCTURE. CONTRACTOR IS SOLELY RESPONSIBLE FOR CONSTRUCTION MEANS, METHODS, SEQUENCES AND OSHA SAFETY PRECAUTIONS, INCLUDING BUT NOT LIMITED TO SHORING AND TEMPORARY BRACING.

C. DIMENSIONS - USE WRITTEN DIMENSIONS ONLY. VERIFY ALL DIMENSIONS AT JOB SITE BEFORE COMMENCING WORK AND REPORT ANY DISCREPANCIES. WHERE NO DIMENSIONS ARE PROVIDED OBTAIN CLARIFICATION PRIOR TO PROCEEDING WITH WORK.

D. COORDINATION - OPENINGS THROUGH WALLS AND FLOORS FOR MECHANICAL AND ELECTRICAL SYSTEMS SHALL BE COORDINATED BY CONTRACTOR AND CONSTRUCTED PER TYPICAL DETAILS SHOWN IN THESE DOCUMENTS. NO MECHANICAL OR ELECTRICAL SYSTEM COMPONENTS SHALL BE EMBEDDED IN SLABS OR WALLS UNLESS SPECIFICALLY DETAILED IN THESE DOCUMENTS.

E. OMISSIONS AND CONFLICTS - OMISSIONS OR CONFLICTS BETWEEN VARIOUS ELEMENTS OF THE CONSTRUCTION DOCUMENTS SHOULD BE BROUGHT TO THE ATTENTION OF THE DESIGN TEAM. IF CERTAIN FEATURES ARE NOT FULLY DELINEATED IN THE CONSTRUCTION DOCUMENTS, THEIR CONSTRUCTION SHALL BE OF THE SAME CHARACTER AS FOR SIMILAR CONDITIONS THAT ARE DELINEATED.

F. STRUCTURAL DRAWINGS ARE INTENDED TO BE USED WITH ARCHITECTURAL AND MECHANICAL DRAWINGS. CONTRACTOR IS RESPONSIBLE FOR COORDINATING SUCH REQUIREMENTS INTO THEIR SHOP DRAWINGS AND WORK.

G. NO CHANGE IN SIZE OR DIMENSION OF A STRUCTURAL MEMBER, NOR SHALL ANY OPENINGS BE MADE IN ANY STRUCTURAL MEMBER, WITHOUT THE WRITTEN APPROVAL OF THE ENGINEER.

H. THE CONTRACTOR IS RESPONSIBLE FOR LIMITING THE AMOUNT OF CONSTRUCTION LOAD IMPOSED UPON STRUCTURAL FRAMING. CONSTRUCTION LOADS SHALL NOT EXCEED THE DESIGN CAPACITY OF THE FRAMING AT THE TIME THE LOADS ARE IMPOSED.

I. THE CONTRACTOR SHALL INFORM THE ENGINEER. IN WRITING OF ANY DEVIATION FROM THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL NOT BE RELIEVED OF THE RESPONSIBILITY OF SUCH DEVIATION BY THE ENGINEER'S REVIEW OF: SHOP DRAWINGS, PRODUCT DATA, ETC., UNLESS THE CONTRACTOR HAS SPECIFICALLY INFORMED THE ENGINEER OF SUCH DEVIATION AT THE TIME OF SUBMISSION, AND THE ENGINEER HAS GIVEN WRITTEN APPROVAL TO THE SPECIFIC DEVIATION.

J. SEE DRAWINGS OTHER THAN STRUCTURAL FOR: TYPES OF FLOOR FINISH AND THEIR LOCATION, FOR DEPRESSIONS IN FLOOR SLABS, FOR OPENINGS IN WALLS AND FLOORS REQUIRED BY ARCHITECTURAL AND MECHANICAL FEATURES, FOR ROADWAY PAVING, WALKS, RAMPS, STAIRS, CURBS, ETC.

- DESIGN BASIS

A. APPLICABLE CODE: ASCE 7-16.

B. VERTICAL LOADS:
   1. HABITABLE ATTIC (LOFT): 30 psf
   2. ROOF LIVE LOAD: VARIES WITH SLOPE (20 psf max.)

C. LATERAL LOADS:
   1. SITE LOCATION:
      JONESTOWN, MISSISSIPPI
   2. DESIGN SEISMIC CRITERIA:
      SITE CLASS: D
      S_{DS} = 0.4g
      S_{D1} = 0.3g
      IMPORTANCE FACTOR, I= 1.0
      SEISMIC DESIGN CATEGORY= D
      OCCUPANCY CATEGORY = II
      RESPONSE MODIFICATION COEFF., R= 6.5
      REDUNDANCY FACTOR = 1.0
      DESIGN SEISMIC COEFF., V= 0.062 W, W (N-S, E-W STRENGTH)
   2. DESIGN WIND CRITERIA:
      RISK: II
      EXPOSURE = C
      BASIC SPEED = 112 MPH
      WIND PRESURE = 24 PSF
      K_{ZT} = 1.0 (FLAT)

D. GEOTECHNICAL CRITERIA:
   1. SOIL PROPERTIES ARE NOT KNOWN IN SUFFICIENT DETAIL TO DETERMINE SITE CLASS THEREFORE SITE CLASS D WAS USED.
   2. ALLOWABLE SOIL BEARING PRESSURE:
      DEAD + LIVE: 1500 psf
      PER IBC TABLE 1806.2

MATERIALS

WOOD

MATERIAL AND WORKMANSHIP PER AWC NATIONAL DESIGN SPECIFICATION

MATERIAL SPECIFICATIONS, TYP. UNO.		MAX. MOISTURE CONTENT
2x STUDS AND BLOCKING	SOUTHERN PINE #1	19%
2x JOISTS AND RAFTERS	SOUTHERN PINE #1	19%
4x,6x,8x	SOUTHERN PINE #1	19%

CONCRETE

MATERIAL AND WORKMANSHIP PER ACI 318-19

MATERIAL SPECIFICATIONS, TYP. UNO.

PAD FOOTINGS f'c = 2500 psi
SLAB ON GRADE f'c = 3000 psi
GRADE BEAMS f'c = 3000 psi
ELEVATED DECKS f'c = 3000 psi
ALL CONCRETE IS NORMAL WEIGHT (150 pcf) UNO

REINFORCING STEEL

MATERIAL AND WORKMANSHIP PER ACI 301

MATERIAL SPECIFICATIONS, TYP. UNO.

REINFORCING STEEL PER ASTM A615 GRADE 60
WELDING REINFORCING PER ASTM A706
WELDED WIRE MESH PER ASTM GRADE 65

STRUCTURAL TESTS AND INSPECTIONS

SPECIAL INSPECTIONS AND TESTING PER IBC CHAPTER 17

SPECIAL INSPECTIONS PERFORMED BY: ___________

FOUNDATION:
GRADING, COMPACTED FILL, EXCAVATIONS

CONCRETE:
PLACEMENT OF 2500 psi CONCRETE OR STRONGER
CYLINDER TESTS OF 2500 psi CONCRETE OR STRONGER

REINFORCING STEEL:
PLACEMENT OF REINFORCING STEEL IN 3000 psi CONCRETE OR STRONGER

WOOD:
CONSTRUCTION OF HIGH-LOAD DIAPHRAGMS

STRUCTURAL SHEET INDEX

ABBREVIATIONS

&	AND
@	AT
A.B.	ANCHOR BOLT
ARCH.	ARCHITECTURAL
BLDG.	BUILDING
BLKG.	BLOCKING
BM.	BEAM
B.N.	BOUNDARY NAIL
B.O.C.	BOTTOM OF CONCRETE
BOT.	BOTTOM
℄	CENTER LINE
C.G.S.	CENTER OF GRAVITY OF POST-TENSIONING STRAND
C.J.	CONTROL JOINT
CLR.	CLEAR COVER
COL.	COLUMN
CONC.	CONCRETE
CONT.	CONTINUOUS
DBL.	DOUBLE
DBO.	DRAWING BY OTHER
DET.	DETAIL
D.C.	DEMAND CRITICAL
D.F.	DOUGLAS FIR
DWG.	DRAWING
(E)	EXISTING
EA.	EACH
EL.	ELEVATION
E.N.	EDGE NAIL
E.W.	EACH WAY
EXT.	EXTERIOR
FDN.	FOUNDATION
FF.	FINISH FLOOR
FL.	FLOOR
F.O.C.	FACE OF CONCRETE
F.O.S.	FACE OF STUD
F.S.	FAR SIDE
FTG.	FOOTING
G.C.	GENERAL CONTRACTOR
GLB	GLUE LAMINATED BEAM
H.D.	HOLD DOWN
HDR.	HEADER
HORIZ.	HORIZONTAL
HSS	HOLLOW STEEL SECTION
J.H.	JOIST HANGER
LONG. TRAN.	LONGITUDINAL TRANVERCE
LW	LIGHT WEIGHT
MAX.	MAXIMUM
MECH.	MECHANICAL
MIN.	MINIMUM
(N)	NEW
NW	NORMAL WEIGHT
NTS.	NOT TO SCALE
O.C.	ON CENTER
OPP.	OPPOSITE
PL	PLATE
PLY.	PLYWOOD
P/T	POST TENSIONING
R.C.J.	ROUGHENED CONSTRUCTION JOINT
REINF.	REINFORCEMENT
REQD.	REQUIRED
S.A.D.	SEE ARCHITECTURAL DRAWINGS
S.C.D.	SEE CIVIL DRAWINGS
SCHED.	SCHEDULE
S.D.B.O.	SEE DRAWINGS BY OTHERS
SIM.	SIMILAR
S.J.	SEISMIC JOINT
S.L.R.S.	SEISMIC LOAD RESISTING SYSYEM
S.M.D.	SEE MECHANICAL DRAWINGS
SPEC.	SPECIFICATION
SQ.	SQUARE
SYM.	SYMMETRICAL
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
T.O.	TOP OF
T.O.C.	TOP OF CONCRETE
T.O.F.	TOP OF FINISH
T.O.S.	TOP OF STEEL FRAMING
T.P.	TOP OF PLATE
TYP.	TYPICAL
U.N.O.	UNLESS NOTED OTHERWISE
VERT.	VERTICAL
V.I.F.	VERIFY IN FIELD
W/	WITH
W/O	WITHOUT

JOURNEYMAN INTERNATIONAL

1 Grand Ave. San Luis Obispo
CA, 93401

INFO:

JOURNEYMAN INTERNATIONAL
SENIOR PROJECT

ADVISOR:
PROFESSOR JOHN LAWSON

DATE:
6/1/2021 9:55:04 PM

PROJECT:

DWELL BEING

SITE:

JONESTOWN, MISSISSIPPI

REVISIONS

No.	DESC.	DATE

DRAWN BY: Author

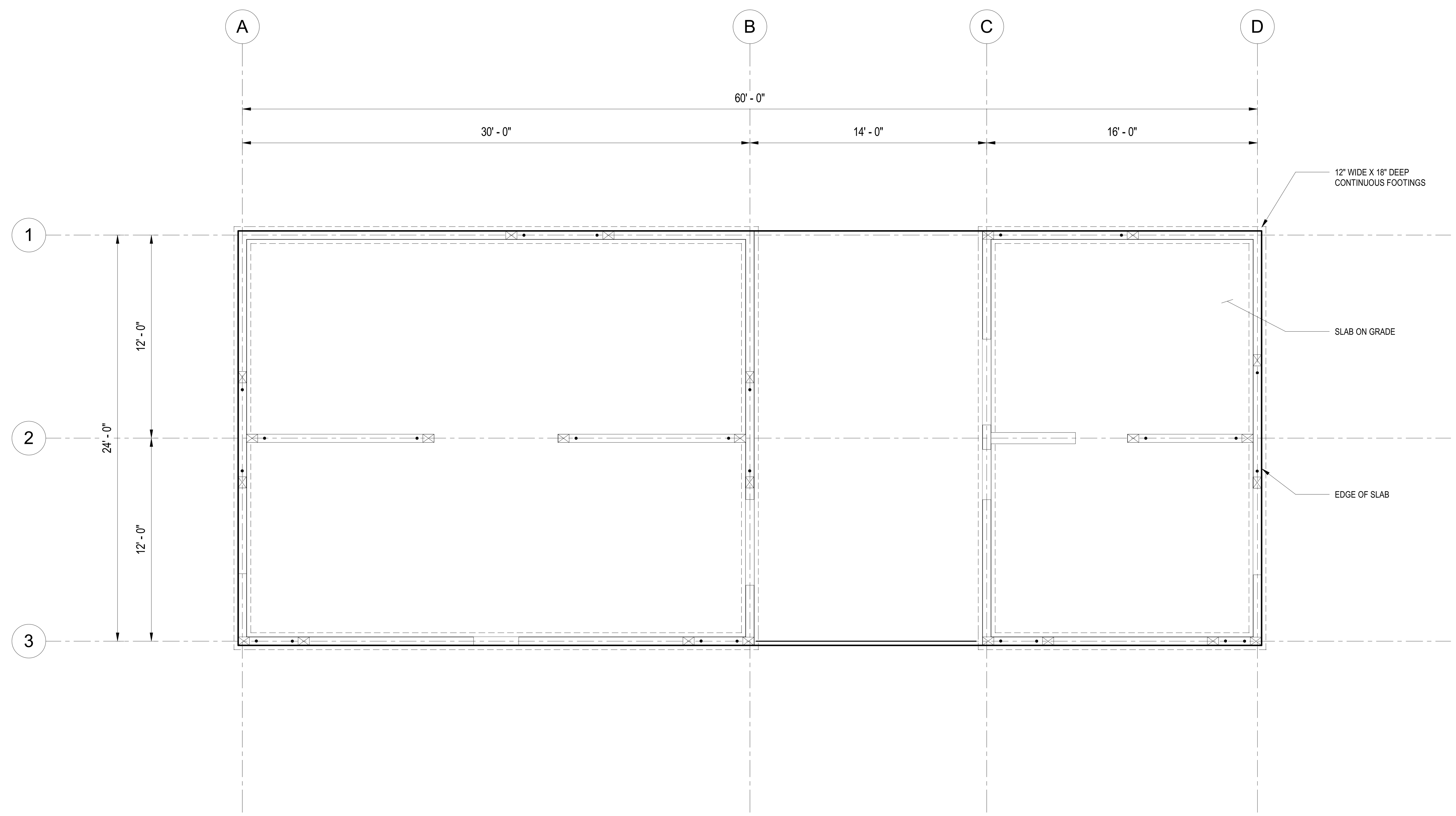
CHECKED BY: Checker

PLOT DATE:
6/1/2021 9:55:04 PM

SHEET NAME:
GENERAL NOTES

SCALE:

SHEET No.:
S.0



1 FOUNDATION PLAN
1/4" = 1'-0"

JOURNEYMAN INTERNATIONAL

1 Grand Ave. San Luis Obispo
CA, 93401

INFO:

JOURNEYMAN INTERNATIONAL
SENIOR PROJECT

ADVISOR:
PROFESSOR JOHN LAWSON

DATE:
6/1/2021 9:55:05 PM

PROJECT:

DWELL BEING

SITE:

JONESTOWN, MISSISSIPPI

REVISIONS

No.	DESC.	DATE

DRAWN BY: AGW

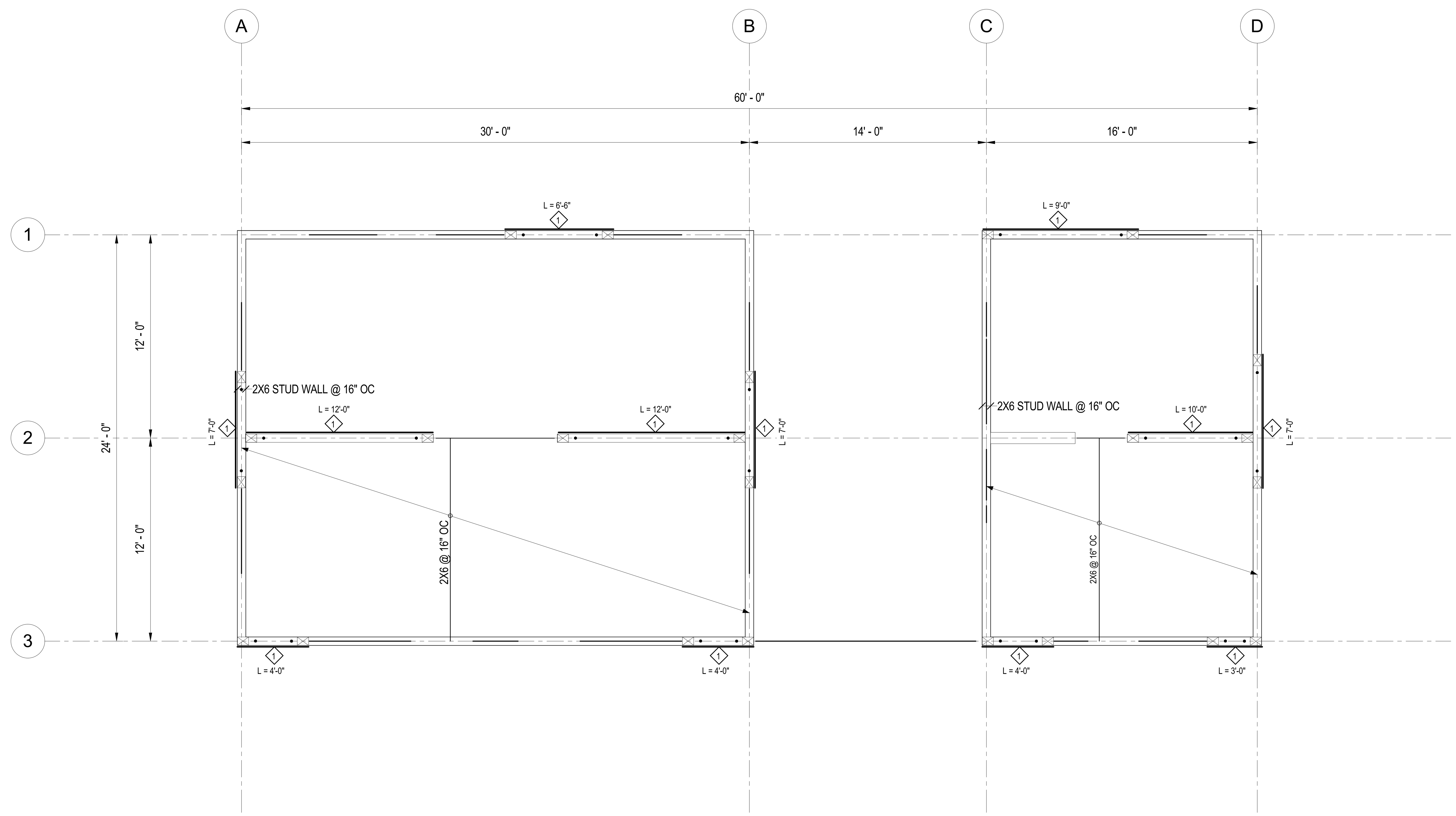
CHECKED BY: JWL

PLOT DATE:
6/1/2021 9:55:05 PM

SHEET NAME:
FOUNDATION PLAN

SCALE:
1/4" = 1'-0"

SHEET No.:
S.1



1 LOFT FRAMING
1/4" = 1'-0"

JOURNEYMAN INTERNATIONAL

1 Grand Ave. San Luis Obispo
CA, 93401

INFO:

JOURNEYMAN INTERNATIONAL
SENIOR PROJECT

ADVISOR:
PROFESSOR JOHN LAWSON

DATE:
6/1/2021 9:55:05 PM

PROJECT:

DWELL BEING

SITE:

JONESTOWN, MISSISSIPPI

REVISIONS

No.	DESC.	DATE

DRAWN BY: Author

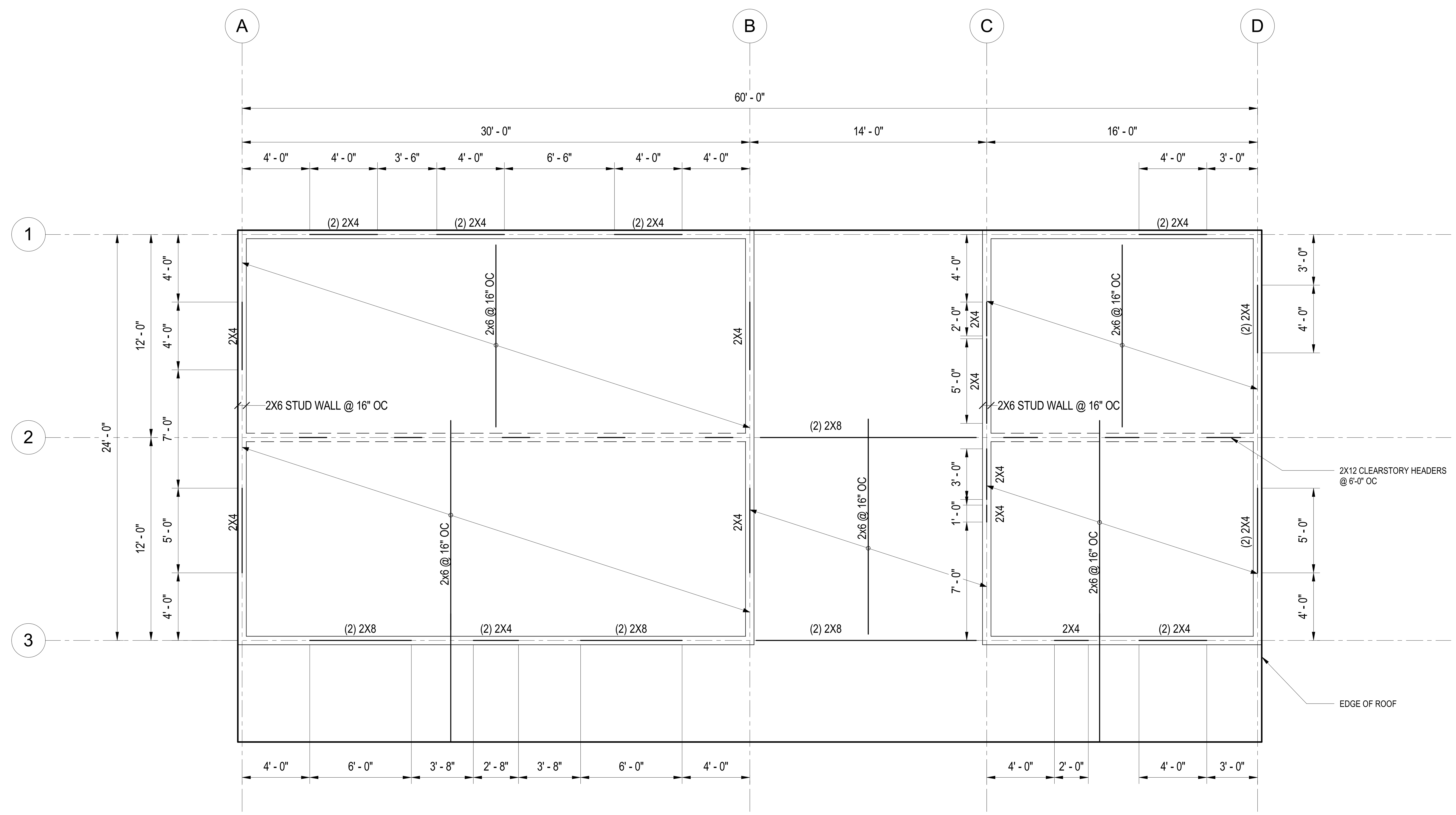
CHECKED BY: Checker

PLOT DATE:
6/1/2021 9:55:05 PM

SHEET NAME:
LOFT FRAMING PLAN

SCALE:
1/4" = 1'-0"

SHEET No.:
S.2



1 ROOF FRAMING
1/4" = 1'-0"

JOURNEYMAN INTERNATIONAL

1 Grand Ave. San Luis Obispo
CA, 93401

INFO:

JOURNEYMAN INTERNATIONAL
SENIOR PROJECT

ADVISOR:
PROFESSOR JOHN LAWSON

DATE:
6/1/2021 9:55:05 PM

PROJECT:

DWELL BEING

SITE:

JONESTOWN, MISSISSIPPI

REVISIONS

No.	DESC.	DATE

DRAWN BY: AGW

CHECKED BY: JWL

PLOT DATE:
6/1/2021 9:55:05 PM

SHEET NAME:
ROOF
FRAMING PLAN

SCALE:
1/4" = 1'-0"

SHEET No.:
S.3

SECTION 4.0 : ALTERNATIVE SOLUTION FOR AFFORDABLE HOUSING IN JONESTOWN, MISSISSIPPI

An affordability study supplementing a completed design project in Jonestown, MS with students from California Polytechnic State University in San Luis Obispo.

Jonestown, Mississippi Summary

General

Size: 0.4 square miles
Population: 1,124
Age: 28% under 18 / 66% age 18 – 64 / 6% over 65
Sex: 56% female / 44% male
Ethnicity: 100% black

Economics

Per Capita Income: $10,372
Median Household Income: $17,596
Persons Below Poverty Line: 46.8% / 523 persons
Common Occupations: Retail / Recreation / Social Assistance

Housing

No. Of Units: 512 / 86% occupied / 14% vacant
Ownership: 56% renter occupied / 44% owner occupied
Type of Structure: 47% single unit / 31% multi-unit / 22% mobile home
Value of Owner Occupied Units: $45,300 median / 92% under $100k / 8% above $100k

Access to Housing

Access to affordable housing is extremely important for an individual's pursuit of education, community involvement, and overall autonomy. The U.S. Department of Housing and Urban Development (HUD) measures the affordability of housing based on the percentage of income that individuals spend on housing. Houses are considered unaffordable if the cost surpasses the 30 percent threshold, or 30 percent of income (Defining Housing Affordability: HUD USER). The 2019 US Census report found that the official poverty rate nationally was 10.5 percent and that the overall national median income for men was $57,456 and $47,299 for women (Bureau, US Census. Income…). The US Department of Health and Human Services defines poverty thresholds for two person, three person, and four person household incomes at $17,240, $21,720, and $26,200 respectively. Jonestown is a small 0.4 square mile town located in Coahoma County, Mississippi with a population of 1,124 people, almost 100 percent black. The 2019 census reported that 46.8 percent of people in Jonestown live below the poverty line (Census Profile: Jonestown, MS). Following the 30 percent HUD rule, the median household income of $17,596 in Jonestown leaves families housing burdened after spending about $5,280 (0.3 x $17,596) on housing a year.

The median value of owner occupied housing in Jonestown is $42,100 (Census Profile: Jonestown, MS). With a Federal Housing Administration mortgage loan with 10 percent downpayment, the average family in Jonestown, Mississippi would need to pay a little more than $4,000 down, plus monthly mortgage payments which meet or surpass the 30 percent threshold. An average 30 year fixed loan in the US in 2021 has a 3.36% interest rate, which approximates a monthly payment of $200 (Tarpley, Laura Grace). While houses valued at about $40,000 in Jonestown can be afforded, there are no new homes being built because they cannot afford to be built. Therefore this is little to no access to new and improved housing because the cost is higher than what is existing and can be afforded. For instance in comparison, the overall average purchase price of single family housing in Mississippi is slightly more than $130,000 for a mortgage, much higher than many families in Jonestown could afford (Tarpley, Laura Grace). Finding affordable housing is important because families, like those in Jonestown, often have to spend so much of their earnings on housing that they often have to choose between other basic necessities such as food and healthcare. There are negative psychological effects not only on adults but for the development and well being of children as well.

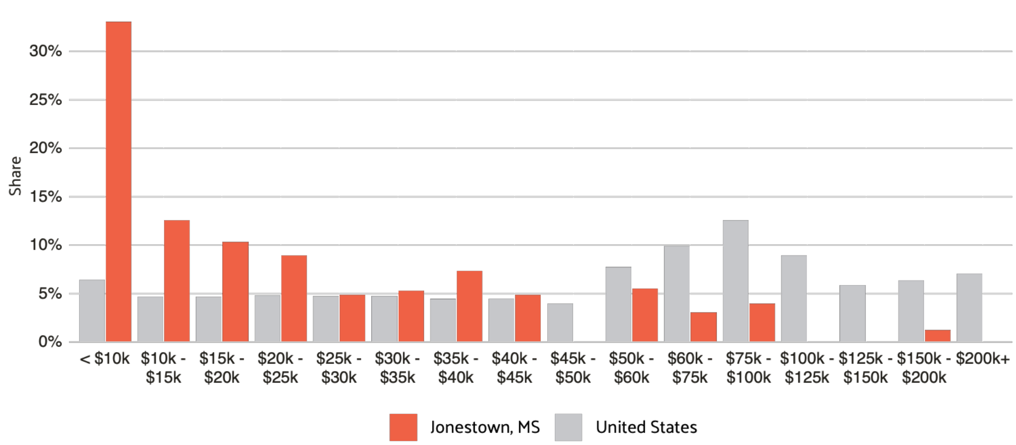


Figure 1: Household income in Jonestown compared to the US

https://datausa.io/profile/geo/jonestown-ms#household_income

Designer Impact

What impact do architectural and structural designers have on the affordability of a structure? The typical cost breakdown of a project attributes 10-20 percent of costs to purchasing the land, 20-30 percent of costs for design, engineering, financing/permitting, and 50-70 percent of costs for construction, labor, and materials (Hoyt, Hannah). Architects and developers have the most influence on the affordability because they make the initial decisions that impact the 50-70 percent hard costs. Developers decide how much profit they want to make and therefore the demographic of people who can afford their product. Architects influence the program and aesthetic of a building, and where the engineers can add structural elements. This all impacts the ability to make an economically efficient structure. Ways to reduce costs include lowering MEP cost by setting up back to back plumbing and correctly positioning windows and glass to avoid inefficient sun exposure. Architects can also select building finishes that are less costly. Engineers can work to select the most cost effective and efficient designs to satisfy the architect and client. By working on a project from the beginning, collaboration with the engineer can help ensure that costs remain as low as possible.

One solution to increase the affordability of a home is by utilizing prefabricated systems and offsite construction. For example, manufactured homes are typically less expensive than a custom built home. The Current Manufactured Housing Survey from the US Census reported that in 2020 the average sales price of a new manufactured double home in the South was $109,900 (Bureau, US Census. Current…). A typical double wide manufactured home is at least 20 feet wide and a maximum of 90 feet long. To transport a double wide homes requires that the home travels in two separate components, not exceeding 14 feet in width or 90 feet in length. These two pieces are then joined together at the site (Over-Dimensional Permits). Applying this methodology can be an effective method to reduce costs with a desirable manufactured house that is not inferior nor unsafe.

Dwell Being

Dwell Being, a project in Jonestown, Mississippi with Journeyman International, But God Ministries, and Third Lens Ministries seeks to find an affordable and resilient housing solution. The student architect designed a 24 foot by 60 foot duplex that can be utilized as two separate households, one for a single individual or couple, and the other for a small family. The duplex can also be purposed for a multigenerational household across both units. This is important because census data suggests that not many people move out of Jonestown. Only 68.6 percent of individuals graduate high school compared to 85.3 percent of individuals in Mississippi and 88.6 percent nationally. Additionally, Jonestown has a disproportionately high percentage of individuals under 18 in poverty at 59 percent compared to 28 percent in Mississippi and 17 percent nationally (Census Profile: Jonestown, MS). The project is very similar to a Southern dogtrot style home with two enclosed spaces separated by a breezeway, all under the same roof. Both sides of Dwell Being have a loft structure providing additional space, very similar to a traditional auxiliary dwelling unit (ADU). What if Dwell Being was a creative and architecturally aesthetic manufactured home? Would the cost differential of a manufactured unit be significant?

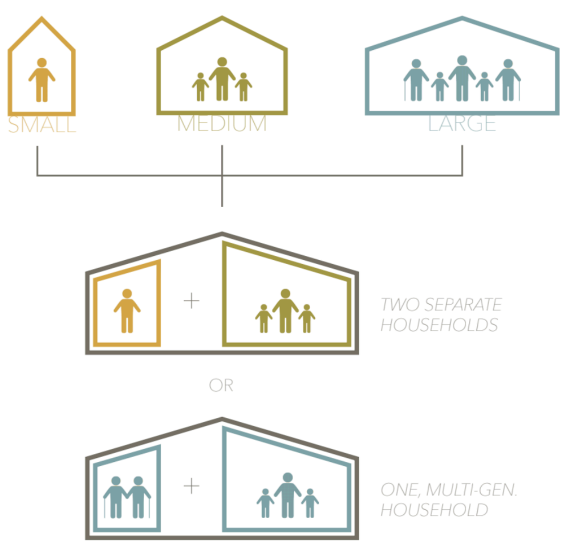


Image 1: Housing concept

Image 2: Example of dogtrot style home

Image 3: Dwell Being rendering

The estimated cost for Dwell Being taken from the student project manager is $175,000 - $200,000. The cost of a similarly designed manufactured home is approximately $100,000 plus the transportation of the manufactured home from a factory (Bureau, US Census. Current…). The closest manufacturers near Jonestown, Mississippi are anywhere from 60 to 160 miles away. With an average cost of about $10 per mile of transportation per vehicle, the additional added cost is anywhere from $600 to $1,600 per vehicle. The Mississippi Department of Transportation would require a manufactured home similar to Dwell Being to be transported on two separate trucks, each carrying a 12 foot by 60 foot section of the structure, with a front escort (Over-Dimensional Permits). If the manufacturing factory is out of Mississippi, the costs of transportation can be up to $20,000. Even with this additional cost, Dwell Being is still 40 percent more expensive being built on site. However, with an increase in manufactured homes it can be assumed that distance to a manufacturer would not be too far away.

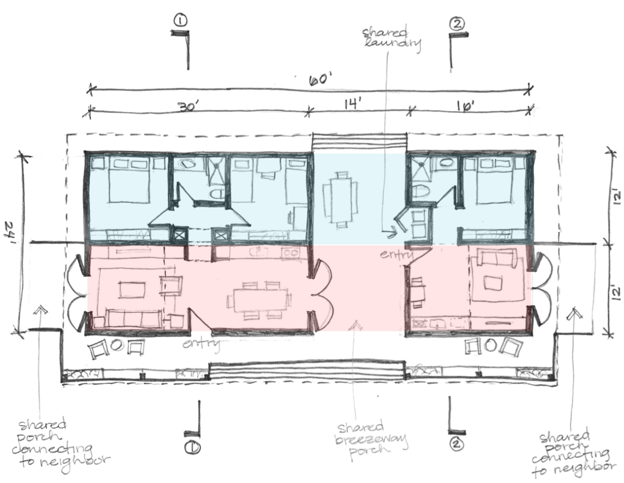


Image 4: Proposal to split manufactured home similar to Dwell Being

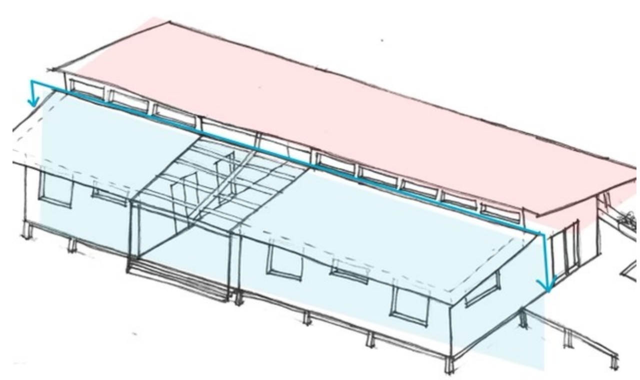


Image 5: 3D section view

Theoretically, the decrease in cost of manufacturing Dwell Being could make the structure more accessible to a larger proportion of an already economically stressed population. The mortgage cost for Dwell Being currently with an FHA loan is almost $20,000 down plus a monthly payment of almost $1,000. This would require about a $32K salary per year to meet the 30 percent rule. Even with multiple families in the duplex, this is inaccessible to many families in Jonestown. If Dwell Being were manufactured, the loan would be $10,000 plus a monthly payment of almost $500. Split by two families this is much closer to a 30 percent housing affordability budget with a required $16K salary, which meets the median household income in Jonestown. Referencing Image 6 below, the curve was created using census data of household incomes in Jonestown. The vertical lines represent the 30 percent income threshold based on an entire year of mortgage payments. This then shows the percentage of families in Jonestown who can comfortably afford the home. The blue line represents the manufactured version of Dwell Being, and then green line represents the on site Dwell Being. The graph shows that by manufacturing the structure, only 22 percent of households in Jonestown do not have access, opposed to 41 percent when the structure is built on site.

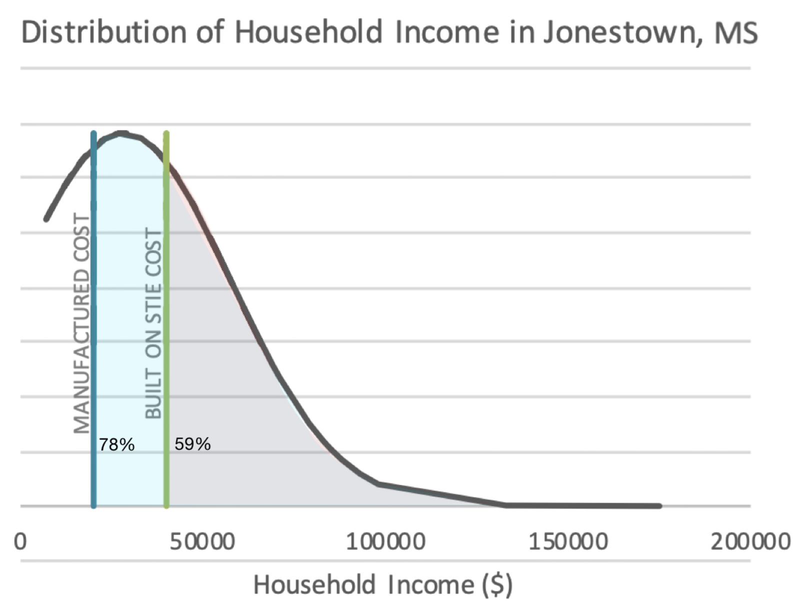


Figure 2: Distribution of household income in Jonestown, MI

Conclusion

Affordable housing is incredibly important to the livelihood of individuals and families. Most American families take housing for granted, however rising costs of living are making it increasingly difficult for individuals working low wage jobs to have consistence access to resources and standards of living. Manufactured housing is a realistic method to reduce housing costs and allow more individuals to have housing ownership. While manufactured housing is often associated with trailer park stereotypes, manufactured homes can actually be aesthetically pleasing and have personal touches to them. While the national average of manufactured homes is only at 6 percent, 15 percent of homes in Mississippi are manufactured, and 22 percent of homes in Jonestown are manufactured. This suggests that it would be easy to implement more manufactured homes into Jonestown and the surrounding area to give more people and more families access to housing. Access to more affordable housing would have broad and positive impacts that could lead to better health and education outcomes. According to the National Low Income Housing Coalition, housing is the key to reducing intergenerational poverty and increasing economic mobility. Further, access to housing is an effective strategy to reduce childhood poverty and increase economic mobility (The Problem). With such a high rate of poverty and high percentage of children under 18 in poverty, more access to housing in Jonestown would be incredibly beneficial.

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